US009262182B2

(12) **United States Patent**
Mullens et al.

(10) **Patent No.: US 9,262,182 B2**
(45) **Date of Patent: Feb. 16, 2016**

(54) **DYNAMIC PARAMETER PROFILES FOR ELECTRONIC DEVICES**

(75) Inventors: **Christopher T. Mullens**, San Francisco, CA (US); **Jesse Michael Devine**, Campbell, CA (US); **Marco Sebastiani**, San Bruno, CA (US); **Nima Parivar**, South San Francisco, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 380 days.

(21) Appl. No.: **13/357,717**

(22) Filed: **Jan. 25, 2012**

(65) **Prior Publication Data**

US 2013/0191625 A1 Jul. 25, 2013

(51) **Int. Cl.**

G06F 1/32	(2006.01)
G06F 9/445	(2006.01)
G06F 9/44	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 9/4451*** (2013.01); ***G06F 1/325*** (2013.01); ***G06F 1/3215*** (2013.01); *G06F 1/3206* (2013.01); *G06F 9/4411* (2013.01); *Y02B 60/185* (2013.01)

(58) **Field of Classification Search**

CPC G06F 1/3215; G06F 1/3265; G06F 1/325
USPC 713/320
See application file for complete search history.

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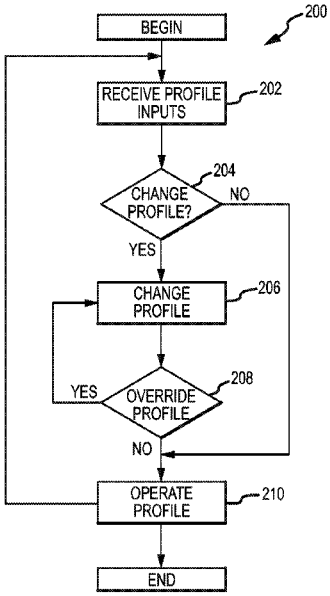
Primary Examiner — Albert Wang
(74) *Attorney, Agent, or Firm* — Downey Brand LLP

(57) **ABSTRACT**

A method for dynamically modifying a characteristic for an electronic device. The method includes activating by a processor a first profile having a first characteristic setting and a first state for an input/output (IO) device. Once the first profile is activated, receiving an input by a sensor and communicating the input to the processor. The method then includes activating by the processor a second profile having a second characteristic setting and a second state for the IO device. The second profile modifies a component of the IO device to include a second characteristic setting and a second state.

20 Claims, 7 Drawing Sheets



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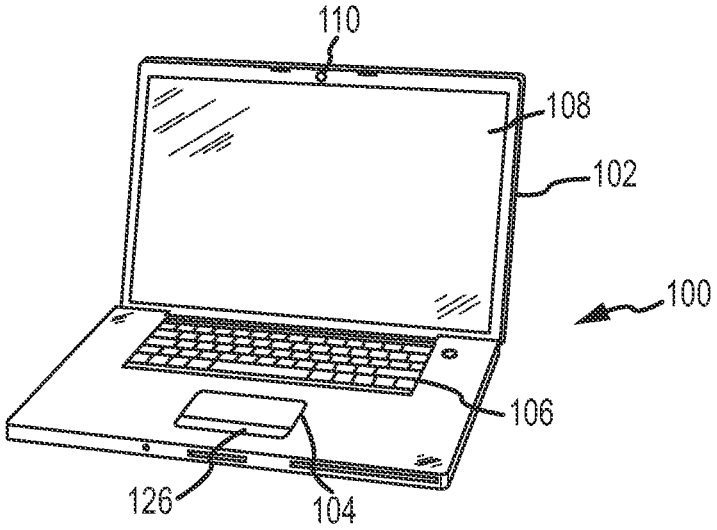

FIG.1A

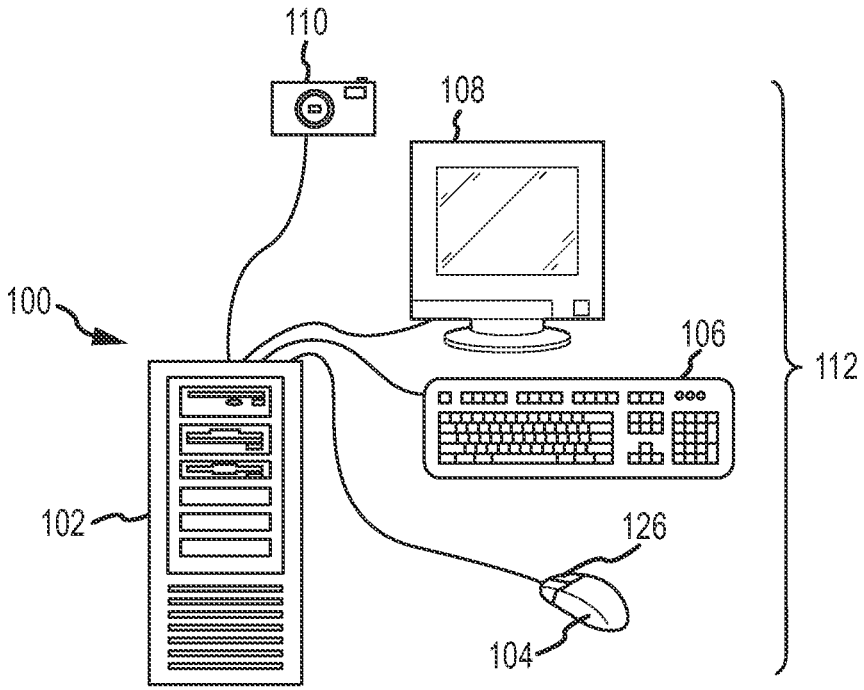

FIG.1B

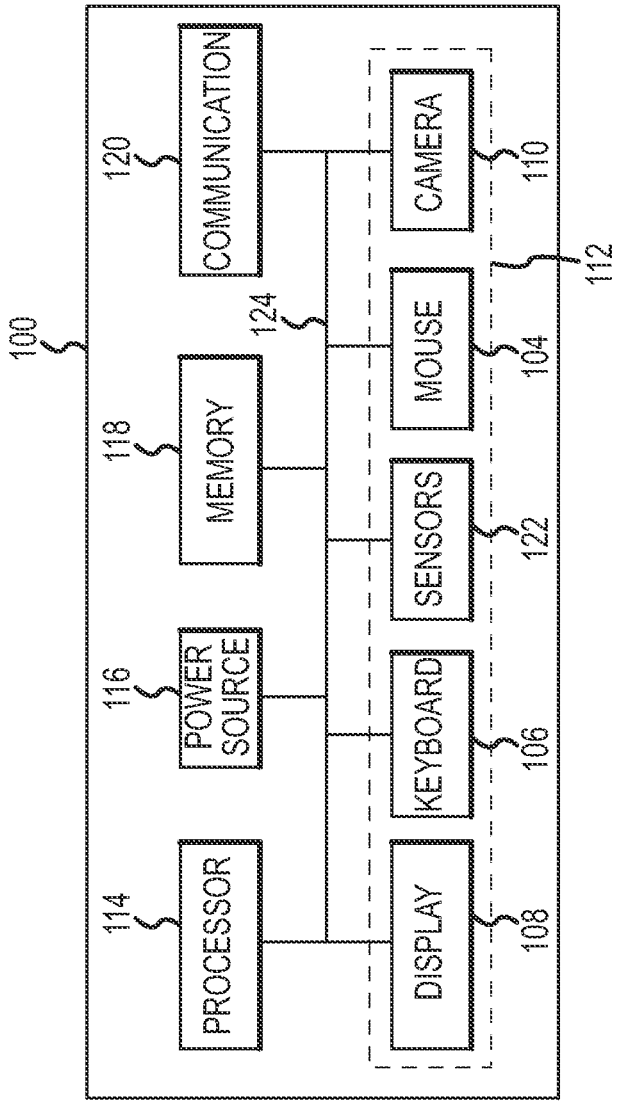
100
PROCESSOR
114
POWER SOURCE
116
MEMORY
118
COMMUNICATION
120
DISPLAY
108
KEYBOARD
106
SENSORS
122
MOUSE
104
CAMERA
110
112
124

FIG. 2

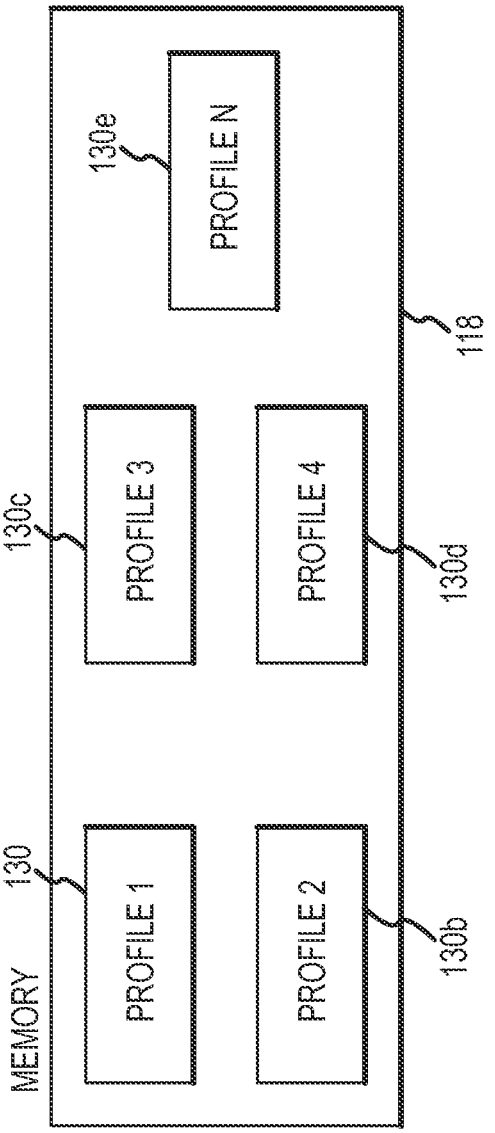
MEMORY
130
PROFILE 1
PROFILE 2
130b
130c
PROFILE 3
PROFILE 4
130d
130e
PROFILE N
118

FIG.3

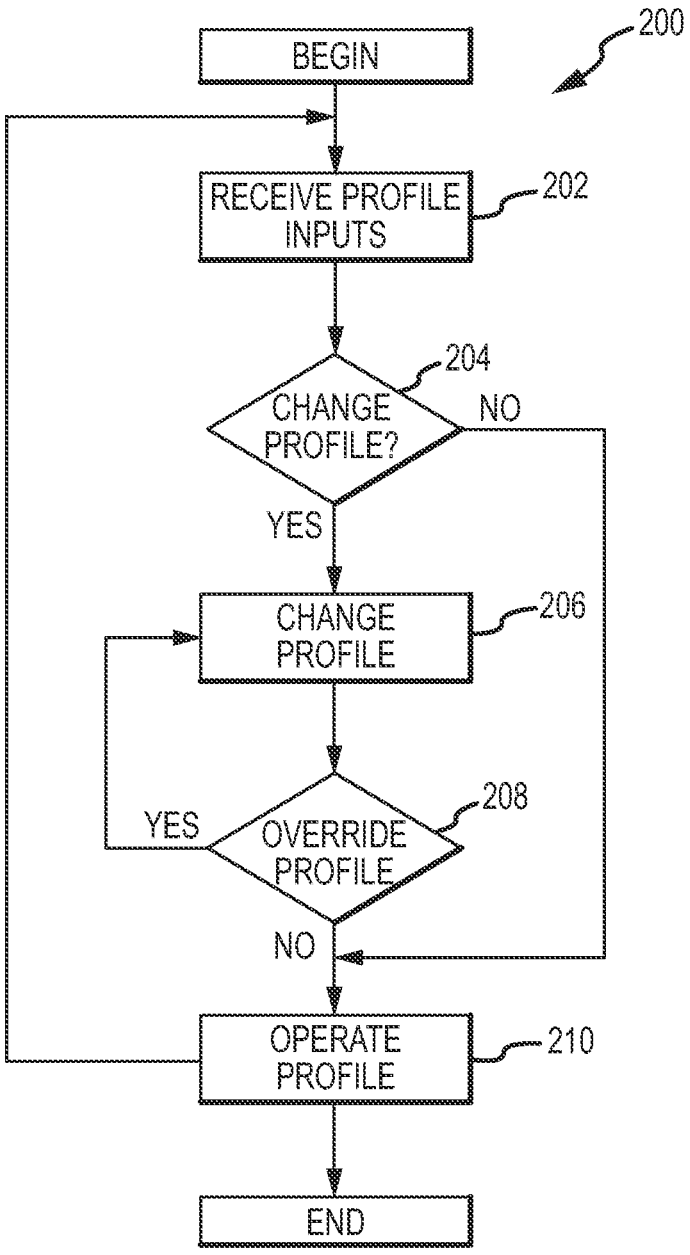
200
BEGIN
RECEIVE PROFILE INPUTS
202
204
CHANGE PROFILE?
NO
YES
CHANGE PROFILE
206
208
YES
OVERRIDE PROFILE
NO
OPERATE PROFILE
210
END

FIG.4

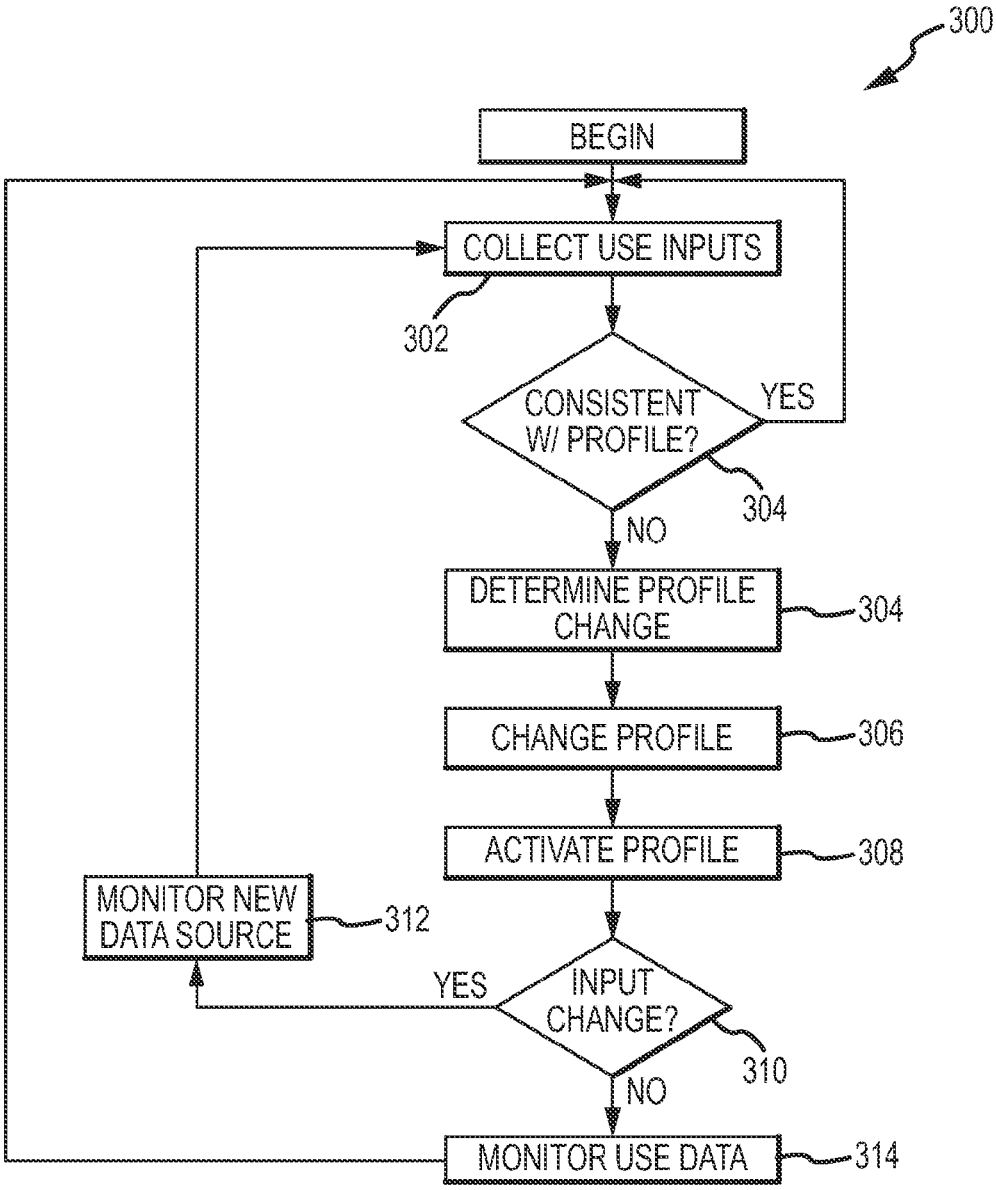
300
BEGIN
COLLECT USE INPUTS
302
CONSISTENT W/ PROFILE?
YES
304
NO
DETERMINE PROFILE CHANGE
304
CHANGE PROFILE
306
ACTIVATE PROFILE
308
MONITOR NEW DATA SOURCE
312
YES
INPUT CHANGE?
310
NO
MONITOR USE DATA
314

FIG.5

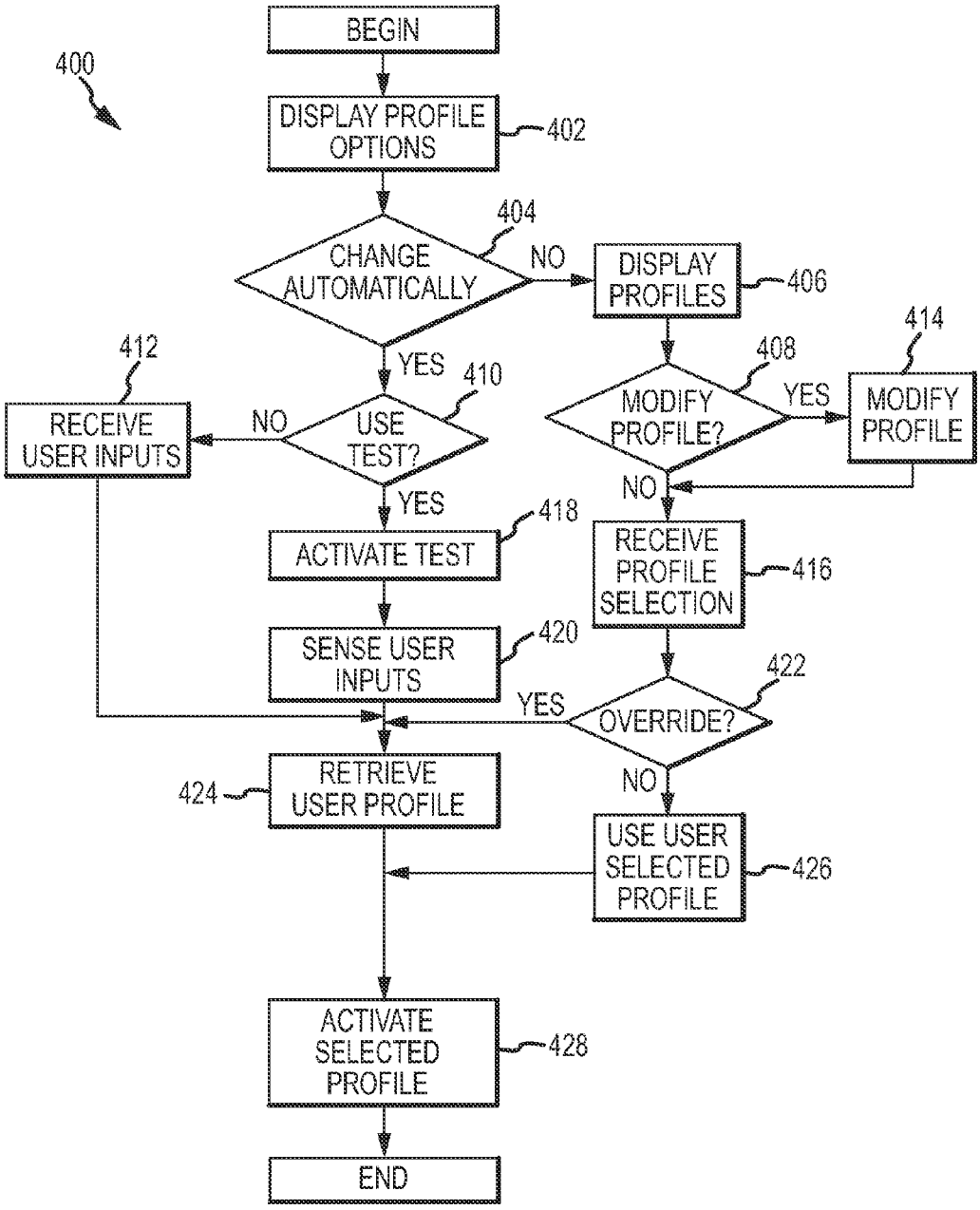
400
BEGIN
DISPLAY PROFILE OPTIONS
402
CHANGE AUTOMATICALLY
404
NO
DISPLAY PROFILES
406
YES
USE TEST?
410
NO
RECEIVE USER INPUTS
412
YES
ACTIVATE TEST
418
SENSE USER INPUTS
420
MODIFY PROFILE?
408
YES
MODIFY PROFILE
414
NO
RECEIVE PROFILE SELECTION
416
OVERRIDE?
422
YES
NO
RETRIEVE USER PROFILE
424
USE USER SELECTED PROFILE
426
ACTIVATE SELECTED PROFILE
428
END

FIG.6

DYNAMIC PARAMETER PROFILES FOR ELECTRONIC DEVICES

TECHNICAL FIELD

The present invention relates generally to electronic devices and more specifically, to power management in electronic devices.

BACKGROUND

Electronic devices such as digital music players, video players, smart phones, mobile gaming devices, laptops, and so on may include a variety of peripheral devices and/or input/output devices such as mice, track pads, displays, keyboards, and so on. These various devices may include a single power management profile that determines whether a particular device is in an active, inactive, sleep, or disconnected state. Based on the particular state, the power management profile may adjust particular settings or parameters for the device. For example, for a mouse, the sampling rate in the sleep state may be significantly less than a sampling rate during the active state. The power management profile for a particular device may typically be stored within firmware for the device. Thus, in many instances, the power management profile may be static for the device. However, often different users may have different usage characteristics, which may not be accommodated by the static profile of the device. For example, a user who uses his or her electronic device to browse the internet may prefer to conserve power in a mouse, as compared to a user who using his or her electronic device to play computer games, who may prefer increased responsiveness in the mouse as compared to power conservation.

SUMMARY

Examples of embodiments described herein may take the form of a method for dynamically altering a characteristic for an auxiliary device in communication with a computing device. The method includes determining by one or more sensors at least one user input corresponding to the auxiliary device; using the at least one user input, determining by a processor whether the at least one user input is consistent with a current profile having a first state and a second state and if the at least one user input is not consistent with the current profile, activating a new profile, wherein the new profile has at least a third state and a fourth state.

Other embodiments may take the form of a computing device. The computing device is in communication with an input/output (IO) device including a sensor configured to detect a user input. The computing device further includes a processor in communication with IO device. The processor is configured to receive the user input detected by the sensor, determine if a current characteristic profile having a current state should be modified based on the user input, and if the current characteristic profile should be modified implementing a new characteristic profile. The new characteristic profile modifies at least one characteristic of the IO device and implements a first state and a second state for the at least one characteristic.

Still other embodiments may include a method for dynamically modifying a characteristic for an electronic device. The method includes activating by a processor a first profile having a first characteristic setting and a first state for an input/output (IO) device. Once the first profile is activated, receiving an input by a sensor and communicating the input to the processor. The method then includes activating by the processor a second profile having a second characteristic setting and a second state for the IO device. The second profile modifies a component of the IO device to include a second characteristic setting and a second state.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a perspective view of a computing device in communication with a plurality of integrated input/output devices.

FIG. **1**B is another embodiment of the computing device in communication with a plurality of separate input/output devices.

FIG. **2** is a block diagram of the computing device.

FIG. **3** is a block diagram of a memory for the computing device including a plurality of profiles for controlling one or more characteristics of the input/output devices.

FIG. **4** is a flow chart illustrating a method for varying a management profile of the computing device.

FIG. **5** is a flow chart illustrating a method for varying the management profile based on use input data.

FIG. **6** is a flow chart illustrating a method for varying the management profile based on user input data.

DETAILED DESCRIPTION

Some embodiments described herein may take the form of a method for dynamically switching one or more parameters or characteristic profiles for an electronic device. The characteristic profiles may control characteristics of one or more input/output or peripheral devices. The controlled characteristics may be related to power consumption, responsiveness, sampling rates, transition times, and so on. The term characteristic is intended to cover substantially any type of parameter, setting, or other data that may control one or more aspects of a device, component, or combination of components. The terms "input/output device," "peripheral device," and "auxiliary device" are intended to cover substantially any type of device that may be in communication with a processor, and may cover input only devices, output only devices, or combination input/output devices.

The methods described herein may provide a number of different profiles that may be related to different user settings, applications, or user behavior. For example, there may be a "gaming profile," a "power saving profile," a "slow typist" profile, and so on. The method may provide for a transition between profiles based on one more use inputs to the electronic device and/or the input/output devices. The transition may be automatic or manual. In other words, the electronic device may change the profile of one or more input/output devices based on sensed inputs or the electronic device may change the profiles based on inputs manually input by the user or user settings.

As a non-limiting example, the method may be used to switch a profile of an input/output device, such as a mouse, between a normal operating profile and a gaming profile. The normal operating profile may regulate a sampling rate of the mouse to a low value, providing a baseline level of responsiveness, in order to provide a power saving benefit to the mouse. The gaming profile may increase the sampling rate of the mouse, providing increased responsiveness, as compared to the normal operating profile. However, while operating the gaming profile the mouse may quickly consume power, as compared to when the mouse is operating the normal operating profile.

Continuing with the example, while a user uses a first application or a group of applications, such as a word pro-

cessing application or internet browser application, the normal operating profile may control select characteristics of the mouse. When the user switches applications to a second application or group of applications, such as a game or other application requiring increased responsiveness from the mouse, the method may switch the profile of the mouse to the gaming profile. Thus, the user experience with the selected application may be enhanced as the responsiveness of the mouse may be increased, which in this case may be preferred over the power saving benefits of the normal operating profile.

To determine whether to switch between a first profile and a second profile, the electronic or computing device may use any one or a combination of the following inputs: use inputs from various sensors and/or from the input/output device (e.g., typing rate, number of fingers used on a track pad, clicking rate, and so on); the user selection (e.g., by using a graphical user interface the user may select one or more profiles or characteristics to modify); user behavior or settings (e.g., fine tracking precision while using a photo editing application); an active application; time of day; the user currently signed into or interacting with the computing device; data provided by other sensors of the computing device (e.g., light sensors, accelerometers, gyroscopes, other motion sensors and the like); and so on.

In some embodiments, the method may also correct a profile if directly selected by the user. For example, if the user selects his or her own profile and based on certain user inputs the computing device may determine that another profile may be better suited for the user, and thus may switch the profile.

It should be noted that each profile may have control or correspond to one or more states for the device. For example, the normal operating profile may have an active, inactive, sleep, and/or disconnected state. Each of these states may have varied characteristic settings for the device, such as a first sampling rate for the active profile and a second sampling rate for the sleep profile. Thus, by dynamically switching between profiles and as each profile may include one more states of the device, various characteristics of the device may be optimally configured based on the current inputs and use of the device.

IO Devices and the Computing Device

Turning now to the figures, an illustrative electronic device that may implement and/or use a method for dynamically switching profiles will now be discussed. FIG. **1**A is a perspective view of a system **100** with a computing device **102** including a plurality of integrated input/output (IO) devices **112**. FIG. **1**B is a perspective view of a second embodiment of the system **100** including a computing device **102** in communication with a plurality of external IO devices **112**. The IO devices **112** may be substantially any type of input/output device and/or peripheral device. For example, in the system **100**, the IO devices **112** may include a mouse **104** or track pad, a keyboard **106**, a display **108**, and/or a camera **110**. As shown in FIG. **1**B, the IO devices **112** may be separate from the computing device **102**, or as shown in FIG. **1**A the IO devices may be integrated therein. Each of the IO devices **112** may be in communication with the computing device **102** either directly or indirectly and either through a wired connection or a wireless connection.

It should be noted that the term "input/output device" is meant to encompass substantially all types of input or output devices. For example, as used herein the term IO device may include devices that perform only input functions, only output functions, or a combination of both. Additionally, the terms IO device, auxiliary device, and peripheral device are used interchangeably herein and are meant to refer to devices both integrated within the computing device **102** or separate therefrom. Moreover, the IO devices **112** illustrated in FIGS. **1**A and **1**B are meant as illustrative and other IO devices **112** are envisioned, such as, but not limited to, joysticks, remote controllers, game controllers, speakers, other electronic devices, and so on.

With reference to FIGS. **1**A and **1**B, the computing device **102** may be substantially any type of computer or electronic device, non-limiting examples of which include a laptop, desktop, server, smart phone, video game console, set top box, or digital music player. FIG. **2** is a block diagram of the system **100** including the computing device and the one or more IO devices **112**. As illustrated in FIG. **2**, the computing device **102** may include a processor **114**, a power source **116**, memory **118**, and a communication mechanism **120**, which may each be in communication by one or more system buses **124**. It should be noted that in some embodiments one or more of the IO devices **112** may include components similar to the computing device **102**. For example, the IO devices **112** may include a processor, memory, and a communication mechanism. These components may be substantially the same as those in the computing device **102**, but may be smaller and/or less powerful.

The processor **114** may control operation of the computing device **102** and/or one or more of the IO devices **112**. The processor **114** may be in communication with the IO devices **112**, the memory **118**, the communication mechanism **128**, and/or sensors **122**. The processor **114** may be any electronic device cable of processing, receiving, and/or transmitting instructions. For example, the processor **114** may be a microprocessor or a microcomputer.

The communication mechanism **120** may receive and transmit various electrical signals. The communication mechanism **120** may be used to send and receive data from the IO devices **112**. Additionally, the communication mechanism **120** may be used to place phone calls from the computing device **102**, may be used to receive data from a network, or may be used to send and transmit electronic signals via a wireless or wired connection (e.g., Internet, WiFi, radio waves, Bluetooth, or Ethernet). In one embodiment, the communication mechanism **120** may include a transmitter in communication with the processor **114** to send data to other devices and a receiver configured to receive signals from other devices.

The memory **118** may store electronic data that may be utilized by the computing device **102**. For example, the memory **118** may store electrical data containing any type of content, non-limiting examples of which include audio files, video files, document files, and data files. Stored data may correspond to one or more various applications and/or operations of the computer. In some embodiments, the memory **118**, as shown in FIG. **3**, may store one or more profiles for the IO devices **112**.

The memory **118** may be of any format, including, but not limited to, non-volatile storage, a magnetic storage medium, optical storage medium, magneto-optical storage medium, electrical storage medium, read only memory, random access memory, erasable programmable memory, and flash memory. The memory **188** may be provided local to and/or remote from the computer.

The power source **116** may be substantially any type of device and/or connection that may provide power to the computing device **102** and/or the IO devices **112**. For example, the power source **116** may be one or more batteries, a power cord configured to connect to a power outlet, or the like.

The computing device **102** may also be in communication with one or more sensors **122**. The sensors **122** may be inte-

grated with the computing device **102** or may be connected to one or more of the IO devices **112**. The sensors **122** may be substantially any type of device configured to detect one more inputs. For example, the sensors **122** may include a capacitive sensor, accelerometer, gyroscope, heat sensor, resistive sensor, moisture sensor, image sensor (which may be separate from or integrated with the camera **110**), force sensor, power sensor, or the like. The sensors **122** may be configured to detect certain user inputs or environmental inputs and as such may be positioned in substantially any location of the system **100**.

With reference to FIGS. **1A-2**, as briefly described above, the system **100** includes one or more IO devices **112**. In some examples, the IO devices **112** may include the mouse **104** (or track pad), the keyboard **106**, the display **108**, and/or a camera **110**. The mouse **104** may be used by the user to move a cursor or other tracking icon across the display **108**. In some instances the mouse **104** may include one or more input buttons **126** that may provide additional inputs to the mouse **104**.

The keyboard **106** may include one or more keys or buttons that may be selected by the user. For example, each key may include a symbol and when selected by the user the symbol may be provided as an input to the computing device **102**.

The display **108** provides an output for the computing device **102** and in some embodiments may also function as an input for the computing device **102** (e.g., as a capacitive or infrared touch screen). The display **108** may be a liquid crystal display, plasma display, light emitting diode display, or the like. In some embodiments, the display **108** may display an output such as a graphical user interface (GUI), an application interface, a cursor or icon correlated to the one or more IO devices **112**, and so on.

As briefly discussed above, the memory **118** may include data correlating to a plurality of profiles that may be used to vary or control one or more characteristics or settings for the computing device **102** and/or IO devices **112**. FIG. **3** is a block diagram illustrating a plurality of profiles that may be used to modify and/or control the settings for a particular IO device **112** and/or the computing device **102**. There may be any number of profiles, and these profiles **130***a*-**130***e* may be stored in the memory **118** which may be part of one or more of the IO devices **112** or the computing device **102**. As shown in FIG. **3**, there may a Profile **1** **130***a*, Profile **2** **130***b*, Profile **3** **130***c*, Profile **4** **130***d*, and so on, up to a Profile N **130***e* (where N is an arbitrary number). However, in actuality there may be fewer or more profiles than those shown in FIG. **3**.

As briefly mentioned above, in some instances, the IO devices **112** may include components that may be similar to, or perform similar functions as, the memory **118** in the computing device **102**. In these instances, the plurality of profiles for a specific IO device **112** may be stored on memory internal to the IO device **112** and then may be accessible to the computing device **102** through a device driver or other connection mechanism. However, in other embodiments, such as shown in FIG. **3**, the computing device **102** may store the profiles **130***a*-**130***e* for each IO device **112**.

Profiles and Characteristics Varied by the Profiles

Each IO device **112** may have a separate profile **130***a*-**130***e* that controls characteristics specific to the IO device **112**. Further, the computing device **102** may include one or more profiles that control characteristics for one or more IO devices **112**, and/or a combination of profile types may be used. In some embodiments a single profile **130***a*-**130***e* may control one or more characteristics for the computing device **102** and each of the IO devices **112**. For example, there may be a gaming profile that may determine certain characteristics for the mouse **104**, the keyboard **106**, the display **108**, and the processor **114**. Or, in other embodiments, a gaming profile may only control the mouse **104**, and thus only characteristics relating to the mouse **104** may be controlled by that profile and the keyboard **106** may have its own separate keyboard gaming profile. In yet other embodiments, a "gaming profile" for the computing device **102** may activate one or more separate "gaming profiles" on one or more IO devices **112**.

Each of the profiles **130***a*-**130***e* may be configured to control or otherwise vary one or more characteristics or settings for the IO devices **112**. For example, each of the IO devices **112** may have one or more characteristics or settings that may be modified depending on a desired behavior (based on the selected profile). As a non-exhaustive and illustrative list, some characteristics which may be changed for a particular IO device **112** may include a report rate, a sampling rate, dots per square inch value (DPI), data quantization values, tracking speed, an acceleration curve, latency, debounce or input sensitivity, timeouts, sensitivity, speed, and/or processor speed. Many of these characteristics may include a compromise between responsiveness, accuracy, and/or power efficiency. Therefore, each of the characteristics may have different settings that may be desired depending on the user, application, or the like. Other characteristics may be modified based upon improving a user experience or based on the particular behaviors or desires of the user.

The report rate or polling rate may determine the frequency at which the IO device **112** reports its determined inputs to the processor **114**. For example, a particular IO device **112** may send data to processor **114** at 1 ms intervals or at 3 ms intervals (these are sample values for illustrative purposes only). The more frequently the IO device **112** may report inputs to the processor **114** the more quickly the IO device **112** may seem to respond to a particular input. However, an increased report rate may also increase the power consumption of the IO device **112**, as the device **112** may have to send data more frequently.

The sampling rate for one or more of the IO devices **112** may determine a rate at which the IO device **112** outputs or samples for new data inputs. In some embodiments, the sampling rate may be a rate internal to the IO device **112** (such as for a sensor of the IO device **112**). The report rate need not necessarily match the sample rate. In some embodiments, the report rate may be lower than the sample rate. Thus, the device **112** may read multiple data packets between reports, and transmit multiple data packets substantially simultaneously to the processor **114**. However, in many embodiments, the sampling rate and the report rate may be selected to the same or approximately the same, so that, as the IO device **112** checks for data, it may then send any new data that it may have collected. In these embodiments, depending on the profile selected, both of these characteristics may be changed simultaneously. However, in other embodiments, the report rate and the sampling rate may be changed separately from each other.

The DPI or counts per inch (CPI) value may refer to characteristics for either the display **108** or the mouse **104**. Depending on the specific IO device **112** the DPI value may affect a different type of setting or characteristic. As an example, the DPI characteristic may control the tracking precision or sensitivity of the mouse **104** or may control an appearance of objects on the display **108**.

In embodiments where the mouse **104** may include an optical sensor to sense motion, the DPI characteristic may be the resolution of the optical sensor. For example, with a DPI set at 800, the mouse **104** may be able to sense motions as small as $\frac{1}{800}^{th}$ of an inch.

With respect to the display **108**, the DPI characteristic may alter the appearance of certain objects, such as icons or the like, displayed on a GUI. It should be noted that the DPI may affect other IO devices **112** in similar manners, and the above examples are meant as illustrative only.

The quantization characteristic may determine a sensitivity for restraining certain data values. In other words, data values may be rounded or packetized into predetermined values, which may control how frequently data is reported by the IO device **112** to the computing device **102**. For example, with respect to the mouse **104**, the quantization value may determine the minimum amount of motion that may be required for the mouse **104** to register motion and create an input report. Continuing this example, with a quantization at a first value the user may have to move the mouse **104** a minimum distance before the mouse **104** generates an input. By adjusting the quantization value, the minimum number may be increased or decreased, which may increase or decrease the sensitivity and/or number of reports generated by the particular IO device **112**.

As another example, with a track pad, a decreased quantization value may reduce the power consumed by the track pad; however, the track pad may be less responsive to "quick taps" by the user. For example, in some instances a user may tap twice on the track pad in rapid succession to indicate a selection or otherwise provide a specific input. With a decreased quantization value, the "quick taps" may not reach the threshold value to be rounded to an input value. In instances where the computing device **102** is portable or running on a portable power source, a decreased quantization may be desired over the decreased responsiveness.

The tracking speed may vary the speed of an output of the IO device **112**. With respect to the mouse **104**, the tracking speed characteristic may vary a speed relationship of a cursor on the display **108** as compared with the speed that the user may move the mouse **104**. For example, a slow tracking speed may require the user to move the mouse faster to achieve the same cursor speed as a fast tracking speed with a slower input motion by the user.

The acceleration curve characteristic may vary the tracking speed for an output of the IO device **112** as a function of acceleration of an input to the IO device **112**. For example, if the mouse **104** is moved quickly across a surface, the speed of a cursor or icon on the display **108** corresponding to the physical movement of the mouse **104** may increase. Conversely, if the mouse **104** is moved slowly or the acceleration is reduced, the speed of the cursor corresponding to the physical movement may decrease, which may allow for increased sensitivity for the mouse **104**. In this example, sensitivity may be related to the mouse **104** movement required to get the cursor to move a certain distance. Thus, if the acceleration curve is more sensitive, the mouse **104** may be moved a shorter distance to get the cursor to move a predetermined distance, as compared with a less sensitive acceleration curve.

The latency characteristic for the IO devices **112** may determine the time difference between when an input may be provided to the IO device **112** and when the input is displayed **108** or otherwise used by the processor **114**. In some embodiments the latency characteristic may affect a processing rate of inputs from a sensor or IO device **112**. For example, a latency may cause the processor **114** to process certain inputs in bursts. Inputs may be reported to the processor **114** normally, but the processor **114** may queue two or more inputs and then process the inputs substantially simultaneously. Such burst processing may be more power efficient for the processor **114** as it may not have to continuously poll for inputs, but this latency may be noticeable to the user as there may be a delay between when the input was provided and when the output is displayed.

The debounce characteristic or button clicks characteristic may control the sensitivity of a button or switch of the IO devices **112**. For example, if a user quickly or forcefully presses a key on the keyboard **106** or the mouse button **126**, a double input may be generated and processed by the system. This may occur when an input device uses a mechanical switch to register user input. The switch may oscillate against a contact one or more times before settling into a rest state, especially if a user presses forcefully against a key. By varying the debounce characteristic, when two or more similar inputs are received close in time to each other, only a single input may be produced by the IO device **112**. In some embodiments, the debounce characteristic may be time-based such that two inputs to the IO device **112** within a threshold time of each other will cause only a single input to be registered by the IO device **112**. With a debounce characteristic incorporated into the keyboard **106**, if the user's input causes a key, button, or the like, to contact the switch multiple times, only a single entry may be acknowledged by the device and/or processed by the system. However, for light-force typists, a high value debounce may prevent the keyboard **106** from registering an input.

The timeout characteristic may control how fast a particular input device **112** may switch between particular states, e.g., active, non-active, and sleep. For example, an input device **112** may wait a first period of time and if no input is received it may transition to a non-active state (which may have a reduced sampling rate and/or report rate). Then, after another period (which maybe or may not be equal to the first period), the input device **112** may transition from the non-active state to the sleep state. The faster a particular input device **112** may transition between states may decrease the power consumed by the device **112**, as some of the states may require less power as the sampling rate or other characteristics may be reduced during a non-active state.

The sensitivity characteristic may control the amount of force, movement, or other user input that may be required to register as an input for the device **112**. In another example, the sensitivity characteristic may determine the ratio between the input from the user and the input provided to the computing device **102**. Similarly, the speed characteristic may determine a minimum input speed required to register an input, a processing speed for select inputs, or the like.

In addition to the various characteristics and/or settings that are discussed above, it should be noted that each input device **112** may have select characteristics that may be adjusted by one of the profiles **130***a*-**130***e* that may not be applicable to the other IO devices **112**. For example, the camera **110** may include an image stabilization feature that may counteract movement from a user while he or she is trying to take a picture. Some users may have relatively steady hands or may always use a tripod, and in these cases this characteristic may be turned off in order to reduce power consumption or increase processing speed of the camera **110**.

As another example, one input device **112** may be a remote control having an operating range of a predetermined number of feet. In other words, the remote control may be able to transmit signals to the computing device **102** from a distance of 20 feet. In some instances, the transmission distance may be increased or reduced based on the profile **130***a*-**130***e*. To increase or decrease the transmission distance additional power may be provided to a transmitter or the remote control may include multiple transmitters that may be activated depending on the operating range characteristic selected.

As yet another characteristic example, the profiles **130***a*-**130***e* may control one or more applications or application settings. Applications may be run, modified, or closed based on the one or more profiles **130***a*-**130***e*. For example, in a "low power profile," unnecessary or power consuming applications may be turned off, or certain features of those applications may be deactivated.

The aforementioned characteristics and settings are meant as illustrative only, and there may be substantially any number of characteristics or settings for the IO devices **112** and/or computing device **102** that may be altered by one or more of the profiles **130***a*-**130***e*.

With reference again to FIG. **3**, Profile **1** **130***a* may control certain characteristics of the mouse **104**. For example, Profile **1** **130***a* may designate a sampling rate and a report rate of 2 ms, a fast acceleration curve, and no timeout. Accordingly, in some instances, Profile **1** may be used when fast responsiveness from the mouse **104** may be desired despite the increase in power consumption. Profile **2** **130***b* may include a fast timeout interval, a reduced sampling rate and/or report rate, and a high quantization value. With Profile **2** **130***b*, the computing device **102** and/or IO devices **112** may have reduced power consumption, but may be sluggish or have reduced sensitivity.

Further, as noted above, the profiles **130***a*-**130***e* may apply to a single IO device **112**, a group of IO devices **112**, all of the IO devices **112**, the computing device **102**, or a combination of the computing device **102** and select IO devices **112**. For example, Profile **3** may include an increased speed, an increased sampling rate, and a reduced timeout for the mouse **104** but may have a reduced speed, a reduced sampling rate, and an increased debounce rate for the keyboard **106**. Thus, a single profile **130***a*-**130***e* may change characteristics in different manners for one more of the IO devices **112**.

Inputs to Vary Profiles

As will be discussed in further detail below with respect to FIGS. **4**-**6**, the system **100** may receive one or more inputs that may be used to determine a profile, switch a profile, or correct a profile for the IO devices **112** and/or computing device **102**. The particular IO device **112** may provide an input to the system **100** that may be used to change its profile or the profile of another device **112**. For example, an input from the display **108** may be used to change a profile of the keyboard **106**.

Some examples of inputs to the system **100** may include mouse movement, input button selection, user presence sensing, use frequency of an input device **112**, use time of an input device **112**, movement, acceleration, network connections, power level, environment, and so on. The inputs may be provided through one of the IO devices **112** or through the sensors **122** of the computing device **102**. For example, the IO devices **112** may include sensors (not shown) that may be used to track one or more inputs for the IO device **112**, which may then be transmitted to the processor **114** or to another input device **112**. The sensors **122** may determine the number of inputs from the user, the time between inputs, the rate of inputs, characteristics of the inputs (e.g., forceful, fast, etc.), and the like.

Additionally, the IO devices **112** themselves may also be used as inputs for the system **100**. For example, the camera **110** may be used to determine if there is a user present in front of the display **108** or to determine an identity of the user (e.g., through facial recognition or the like).

Other inputs may include the type of applications running on the processor **114**, icons displayed on the GUI, power source of the computing device **102** or the IO devices **112** (e.g., wired, battery, battery type), altitude, time, day, or the like. For example, while a photo-editing application is running or active, a profile for increased mouse **104** sensitivity may be implemented. As another example, at night-time or low-use hours a "sleep profile" may be implemented to save power for the various IO devices **112**. There may be substantially any number of inputs for the system **100** and those inputs may come from the sensors **122** of the computing device **102**, sensors of the IO devices **112**, the IO devices **112** themselves, or from other sources.

Switching Between Profiles

Using one or more inputs, the profile **130***a*-**130***e* for one or more of the IO devices **112** and/or computing device **102** may be switched or varied. The switching may be static or may occur dynamically and may adjust as certain inputs vary. FIG. **4** is a flow chart illustrating a method for changing between profiles for the one or more IO devices **112**. The method **200** may begin with operation **202** and the processor **114** or a processor for one of the IO devices **112** may receive one or more profile inputs. As described above, the profile inputs may be substantially any type of input that may be determined by the sensors **122**, the IO devices **112**, or the computing device **102**. Additionally, the inputs may be automatically collected (e.g., through the sensors **122**) or they may be manually received as they may be directly or manually input by the user. For example, the user may provide inputs regarding his or her desired characteristics for a particular IO device **112**.

Once the profile inputs have been received, the method **200** may proceed to operation **204**. In operation **204** the processor **114** may determine whether a current profile for one or more of the IO devices **112** may need to be changed. For example, the mouse **104** may be operating Profile **1** **130***a* which may have an increased sampling rate and may be used when the user is playing a game on the computing device **102**. However, in operation **202** an input indicating that the game application has been terminated and a word processing or internet browsing application has been activated may be received by the processor **114**. In this example, in operation **204**, the processor **114** may activate Profile **2** **130***b* for the mouse **104**, where Profile **2** **130***b* may have a reduced sampling rate and an increased timeout interval as compared with Profile **1** **130***a*. In other words, in operation **202** the processor **114** may analyze the profile input(s) to determine if the current profile may be optimal or preferred based on the current inputs.

In operation **204**, if the processor **114** determines that the current profile may need to change, the method **200** may proceed to operation **206**. In operation **206** the processor **114** may change the profile for the one or more IO devices **112**. As the profiles **130***a*-**130***e* may correspond to the characteristics of the one or more IO devices **112**, when the profile is changed, one or more characteristics for the one or more IO devices **112** may be altered. Furthermore, as the profiles **130***a*-**130***e* may also vary characteristics of the computing device **102** and/or processor **114**, by changing the profile in operation **206** certain characteristics for the computing device **102** and/or processor **114** may also be changed.

Prior to or after the profile has been changed, the method **200** may proceed to operation **208**. Operation **208** may determine whether the selected profile should be overridden or corrected. In some instances the user may provide manual inputs that may require a specific profile to be implemented, but based on certain other inputs the system **100** may determine that another profile may be better. As a specific example, the user may have indicated a profile selection for a "no-sleep" profile for the entire system **100**. However, based on the time of day and/or typical user behavior, the processor **114** may determine that this profile selection is not ideal and may

override or correct the user selected profile. This type of profile correction is discussed in more detail with respect to FIG. **6**.

In operation **208**, if the profile should be overridden, the method **200** may return to operation **206** and the profile may be changed again. However, in operation **208**, if the profile is not overridden, the method **200** may proceed to operation **210**. In operation **210** the processor **114** may activate one or more profiles **130***a*-**130***e* in the one or more of the IO devices **112**. Once active, the particular IO device **112** may have adjusted operating characteristics, as well as adjusted states that may determine further characteristics. For example, one profile **130***a*-**130***e* may have an active, non-active, and a sleep state and in each of those particular states select characteristics of the IO device **112** may be varied.

In some embodiments, the profile for the one or more of the IO devices **112** may be adjusted substantially automatically by the system **100**. FIG. **5** is a flow chart illustrating a method for changing a profile by automatically detecting one or more inputs. The method **300** may begin with operation **302** and the inputs may be collected. In some instances, the inputs may be related to use data for the one or more of the IO devices **112**. For example, the collected inputs may be related to the typical usage by the user or inputs entered manually. Examples of these inputs may include how fast a user moves one or more the IO devices **112**, the types of applications a user typically utilizes on the computing device **102**, how many fingers he or she uses to select a particular input (e.g., track pad input), and so on. In other instances, the inputs may be unrelated to the user, such as inputs related to the overall movement of the IO device **112** or the computing device **102**, a remaining charge in a battery source, a location of the IO device **112** or the computing device **102**, or the like.

Once the inputs have been collected, the method **300** may proceed to operation **304** and the processor **114** may determine whether a current profile is consistent with the use inputs. For example, if a user is a "hunt and peck" typist, then a profile for the keyboard **106** including a high sampling rate may be inconsistent with the use inputs as the user may not provide inputs at a frequency fast enough to justify the increase in power consumption that may occur with the increased sampling rate. As another example, with a track pad, the user may consistently position his or her full palm on the track pad when he or she is moving the cursor or typing on the keyboard **106**. In this example, a profile having a sensitive debounce or sensitive track pad may be less desirable than a profile that has a reduced sensitivity or debounce so that accidental selections of the track pad (e.g., by depressing the track pad) may be prevented.

In operation **304**, if the processor **114** determines that the current profile is not consistent with the inputs, the method **300** may proceed to operation **304**. In operation **304** the processor **114** may determine a new profile for the one or more input devices **112**. Once the new profile has been determined, the method **300** may proceed to operation **306** and the processor **114** may change the profile for the one or more input devices **112**. The method **300** may then proceed to operation **308** and the profile may be activated on the one or more input devices **112**.

After the new profile has been activated on the one or more IO devices **112**, the method may proceed to operation **310**. In operation **310** the processor **114** may monitor the IO devices **112**, the sensors **112**, and the like to determine if there is an input change. An input change may be related to a change in the IO devices **112** being utilized by the user, a change in an application by the user, a change in user behavior, or the like. In operation **310**, if there is a change in the input type, the method **300** may proceed to operation **312** and a new input data source may be monitored. For example, if the user switches from using the keyboard **106** to using the mouse **104**, the processor **114** may monitor data from the mouse **104** rather than data from the keyboard **106**. However, if in operation **310** there is not a new source of data, then the method **300** may proceed to operation **314** and the same input data may be monitored for changes. At operation **314**, the method **300** may return to operation **302** and new and/or additional input use data may be collected.

In other embodiments, the user may assist in changing a profile for the one or more IO devices **112**. FIG. **6** is a flow chart illustrating a method for changing a profile based on direct or manual user input. The method **400** may begin with operation **402** and an application may be initiated and displayed on the display **108**. The application may allow the user to adjust certain profiles **130***a*-**130***e*. After the profile options application and/or icon is displayed, the method **400** may proceed to operation **404**. Operation **404** determines whether the user wishes to have the processor **114** change the profiles **130***a*-**130***e* automatically or whether the user wishes to change the profiles **130***a*-**130***e* manually.

In operation **404**, if the user provides an input to one of the IO devices **112** that he or she wishes to change the profiles **130***a*-**130***e* of the one or more IO devices **112** manually, the method **400** may proceed to operation **406**. In operation **406** the display **108** may display on the GUI one or more of the profiles **130***a*-**130***e*. The display of the profiles **130***a*-**130***e* may include a listing of one or more of the characteristics or settings that may be altered by a particular profile **130***a*-**130***e*. Alternatively or additionally, the profiles **130***a*-**130***e* may be listed with a description of the goal or theme of the specific profile. For example, if one of the profiles **130***a*-**130***e* is optimal for a mouse or joystick based computer game, it may indicate that in the description (e.g., "Joystick Gaming Profile").

After operation **406**, the method **400** may proceed to operation **408** and the display **108** may display an option whether the user may wish to modify one or more of the profiles **130***a*-**130***e*. In operation **408**, if the user provides an input indicating that he or she wishes to modify one or more of the profiles **130***a*-**130***e* the method **400** may proceed to operation **414** and the user may modify one of the profiles **130***a*-**130***e*. As described above, the profiles **130***a*-**130***e* may include values or settings for one or more characteristics of one or more IO devices **112**. Thus, in operation **414** the method may allow a user to select certain characteristics for one or more profiles **130***a*-**130***e* that he or she may change. This may allow the profiles **130***a*-**130***e* to be customized based on the desires of a particular user. For example, a user may wish to use a "power saving" profile, but may still want a highly responsive mouse. In this case, the user may modify the predetermined "power saving" profile to vary the sampling rate or other characteristic of the mouse **104**, while maintaining the previous settings of the other characteristics.

In operation **408**, if the user selects to not modify any of the profiles **130***a*-**130***e*, the method **400** may proceed to operation **416**. In operation **416** the computing device **102** may receive a profile selection from the user. The profile section may include one more of the profiles **130***a*-**130***e* stored in the memory **118** or may include one or more of the profiles modified by the user. Furthermore, the profile selection may be for a single profile **130***a*-**130***e* or for a set of profiles **130***a*-**130***e* that may be active depending on one or more of the particular inputs. For example, the user may select rules for the processor **114** to dynamically adjust profiles **130***a*-**130***e*. In this example, the user may select a first profile to be

activated when a specific application is operating (e.g., a slow keyboard sampling rate when an internet browser is open), and a second profile to be activated when a minimum level of movement is exceeded (e.g., increased debounce for the keyboard **106** if the accelerometer registers a threshold amount of movement).

The method **400** may then proceed to operation **422** and the processor **114** may determine whether the user's selection should be overridden. For example, the user may have selected certain profiles **130***a*-**130***e* that may be less than ideal for a sensed user behavior or other user inputs. For example, the user may have indicated that he or she wishes to have a high sampling rate for the keyboard **106** but in actuality may be a slow typist, where the increased sampling rate does not equal an increase in performance for the keyboard **106**. Thus, the user's selection of a high sampling rate may be overridden. In this case, the method **400** may proceed to operation **424** and a user profile (as created by the processor or selected by the processor **114**) may be retrieved, this is discussed in more detail below.

In operation **422**, if the user-selected profile(s) is not overridden, the method **400** may proceed to operation **426** and the system **100** may implement the user selected profile(s). The method **400** may then proceed to operation **428** and the selected profile may be activated for the one or more IO devices **112**. Alternatively or additionally, the selected profile may be stored in the memory **118** and may be activated under the correct circumstances or predetermined inputs.

Referring again to operation **404**, if the user determines that he or she would like the computing device **102** to change the profile(s) automatically, the method **400** may proceed to operation **410**. In operation **410**, the computing device **102** may determine whether the user would like to complete a use test or not. For example, the use test may be an application that provides sample applications or situations and the user may use select IO devices **112** as he or she may do normally. The system **100** may then have a test profile that may have an increased sampling rate, more active sensors, or other input collection mechanisms in order to better determine the behaviors and tendencies of the user.

In operation **410**, if the user wants to use the use test, the method **400** may proceed to operation **418** and the test may be activated. As briefly described above, the computing device **102** may activate a test application and/or may activate a test profile to collect data from the user. Once the use test has been activated, the method **400** may proceed to operation **420** and the one or more IO devices **112** and/or the sensors **122** may sense various user inputs.

In operation **410**, if the user did not select a use test, the method **400** may proceed to operation **412**. In operation **412**, the system **100** may collect and/or receive various user inputs from the one or more IO devices **112** and/or sensors **122**. However, these inputs may be received outside of a specific "test" program and rather while a user is using the system **100** normally.

After either operations **412** or **410**, the method may proceed to operation **424** and the selected profile may be retrieved from the memory **118**. The profile **130***a*-**130***e* retrieved may be one or more of the profiles **130***a*-**130***e* stored in the memory **118** or may be a new profile created by the processor **114** based on the selected user's behaviors/tendencies. Once the profile is retrieved, the method **400** may proceed to operation **428** and the selected profile may be activated on the one or more IO devices **112**. After the profile **130***a*-**130***e* is selected it should be noted, that in some embodiments, the system **100** may continue to receive inputs from the IO devices **112** and may dynamically alter the profile based on new inputs or the like.

CONCLUSION

The foregoing description has broad application. For example, while examples disclosed herein may focus on IO devices, it should be appreciated that the concepts disclosed herein may equally apply to substantially any component of a computing device or in communication with the computing device. Similarly, although the inputs may be discussed with respect the IO devices, the methods are equally applicable substantially any type of input, as sensed by sensors within the computing device or separate therefrom. Accordingly, the discussion of any embodiment is meant only to be exemplary and is not intended to suggest that the scope of the disclosure, including the claims, is limited to these examples.

What is claimed is:

1. A method for transitioning an operating profile for an input/output (IO) device connected to a computing device, the method comprising:

at the computing device:

operating the IO device according to a first profile that is associated with an application that is activated;

determining whether a rate of a user input received from the IO device is in accordance with the first profile or a second profile, wherein the first profile and the second profile are each associated with different sampling rates for an input to the IO device and different reporting rates for an output of the IO device; and

when the rate of the user input received from the IO device is in accordance with the second profile: automatically overriding the first profile with the second profile.

2. The method of claim **1**, wherein the IO device is integrated within the computing device or is external to the computing device.

3. The method of claim **1**, wherein the determining is based on at least one of the following: a sampling rate, a report rate, a dots per inch value, a debounce value, an acceleration curve, a timeout time, and a quantization value.

4. The method of claim **1**, wherein the IO device includes one or more of the following: a touch screen, a mouse, a display, a track pad, a joystick, a camera, a speaker, a remote control, and a keyboard.

5. The method of claim **1**, wherein the computing device is connected to an auxiliary device, and the second profile modifies a first operational characteristic of the IO device and a second operational characteristic of the auxiliary device.

6. The method of claim **1**, wherein automatically overriding the first profile with the second profile reduces a polling rate of the IO device.

7. The method of claim **1**, wherein the user input comprises at least one of the following: a number of fingers of a user who is interacting with the IO device, and a magnitude of force by which the user is interacting with the IO device.

8. The method of claim **1**, wherein the first profile and the second profile are each associated with a reporting rate that determines a frequency at which the IO device reports inputs to the computing device.

9. The method of claim **8**, wherein the reporting rate contributes to a power consumption of the IO device, and overriding the first profile with the second profile reduces the power consumption of the IO device.

10. The method of claim 1, wherein the IO device includes at least one of a force sensor, a moisture sensor, an accelerometer, a gyroscope, a heat sensor, a capacitive sensor, and a power sensor.

11. A computing device, comprising:

a communications interface configured to communicate with an input/output (IO) device operating according to a first profile that is activated when an application is opened;

a processor configured to receive a user input from the IO device and determine whether the user input is in accordance with the first profile or a second profile associated with the IO device, wherein the first profile and the second profile correspond to different sampling rates for an input to the IO device and different reporting rates for an output of the IO device;

a storage device configured to store instructions that, when executed by the processor, cause the computing device to automatically override the first profile with the second profile when the user input received by the IO device reaches or exceeds a minimum level of user input.

12. The computing device of claim 11, wherein the computing device is connected to an auxiliary device, and the second profile modifies a first operational characteristic of the IO device and a second operational characteristic of the auxiliary device.

13. The computing device of claim 11, wherein the IO device comprises a touch screen, a keyboard, a mouse, a track pad, camera, a speaker, a display, a joystick, or a remote control.

14. The computing device of claim 11, wherein automatically overriding the first profile with the second profile comprises:

updating multiple characteristics of the computing device associated with the IO device in accordance with the second profile.

15. The computing device of claim 11, wherein the user input comprises a series of inputs received at the IO device.

16. The computing device of claim 11, wherein the IO device includes at least one of a force sensor, a moisture sensor, an accelerometer, a gyroscope, a heat sensor, a capacitive sensor, and a power sensor.

17. A non-transitory computer readable storage medium configured to store instructions that, when executed by a processor included in a computing device, cause the computing device to transition an operating profile of an input/output (IO) device that is in communication with the computing device, by carrying out steps that include:

operating the IO device according to a first profile that is associated with an application that is activated on the computing device;

determining whether a user input received from the IO device is in accordance with the first profile or a second profile, wherein the first profile and the second profile are each associated with different sampling rates for an input to the IO device and different reporting rates for an output of the IO device; and

when the user input received by the IO device is in accordance with the second profile: automatically overriding the first profile with the second profile.

18. The non-transitory computer readable storage medium of claim 17, wherein automatically overriding the first profile with the second profile causes the IO device to consume less power.

19. The non-transitory computer readable storage medium of claim 17, wherein automatically overriding the first profile with the second profile modifies a setting of the application.

20. The non-transitory computer readable storage medium of claim 17, wherein the IO device includes at least one of a force sensor, a moisture sensor, an accelerometer, a gyroscope, a heat sensor, a capacitive sensor, and a power sensor.

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